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CRITICIZES EXCESS WEIGHT IN SOVIET AUTOMATIC PARTS; ZIS-150 TRUCK OUTPUT 100,000 YEARLY

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The need to reduce the weight of trucks and automobiles is a serious problem in the automobile industry, the solution of which would bring about great savings and improve production techniques. The excessive durability norms prevailing for many machine parts lies as a heavy burden on many branches of industry. In the automobile industry, these excessive reserve margins cause overconsumption of materials on a huge scale and in many cases lower the productivity index of vehicles. Reducing the weight of trucks, in particular, while preserving their required index of reliability, would increase their load capacity. Consequently, this would reduce the number of vehicles required for transport purposes.

In the automobile industry, it is impossible to limit the problem to considerations of durability norms. There are certain dynamic factors, depending on the conditions under which loaded vehicles operate, which make the designer's task very difficult. A mere computation of minimum durability norms is no solution. The designer, guided as a rule by mere intuition without reference to operating conditions, is led to produce larger and heavier vehicle parts.

There are cases where plants, faced with certain complaints, are led to strengthen one part or another, while there has been almost no effort to reduce the weight of a part, even when there is no doubt that this would cause no breakage or more rapid wear and tear.

Moreover, there are cases where the struggle for reliability in vehicles becomes a smoke screen, behind which the automobile grows more and more encumbered with metal, which not only fails to increase its reliability but lowers, in many cases, its operational qualities.

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While minimum durability norms for mobile loads have not yet been adequately worked out, a number of experimental methods devised in various branches of the automobile industry, such as the use of tensometers, make it possible to gauge the tension in various parts of a vehicle during its motion under any conditions.

It is impossible to give a ready-made prescription for the solution of this problem without examining the actual process of production within the plant. The present article will touch upon only a few possibilities of reducing the weight of vehicle parts.

The slightest reduction in the weight of a single part makes possible the reduction of other parts as well. This process, gradually extended, can bring about substantial changes in the design of a vehicle both in quality and quantity.

By way of example, the possibility of weight reductions will be pointed out in the case of the ZIS-150 truck. Its piston pin has an external diameter of 28 millimeters and weighs 220 grams, whereas the piston pin in other engines, similar to the ZIS-150 in their dimensions, is only 25.4 millimeters in diameter and weighs 200 grams. Insofar as the larger diameter gives greater wear resistance, there is no objection to it; but a larger external diameter ought to be accompanied by a smaller thickness in the walls and possibly a lighter weight. Nevertheless, the thickness of the ZIS-150 pin is greater than than of the others. It might seem that a saving of 120 grams on a six-cylinder engine is too small a quantity to be worth mentioning. However, since the annual output of ZIS-150 trucks is about 100,000 vehicles, the saving would amount to 12,000 kilograms of highgrade metal.

A more important consideration in this case is that the piston pin together with the piston completes 4,000 strokes per minute and places certain dynamic loads on the crank and piston system. Even a slight decrease in the initially moving weights and, correspondingly, in the forces of inertia, would permit a slight reduction in the weight of the piston rod and, consequently, a change in the design of the crankshaft (with a view to reducing its weight) and its supports. A careful computation will show that the 20 grams saved on the piston would lead to kilograms of savings in related parts. Regularity of operation in a given mechanism depends in large measure on the toughness of the parts and supports rather than on their amount of metal. Toughness is achieved not through quantities of metal but the proper distribution of supports, such as stiffening ribs, balance beams, etc.

The ZIS-150 engine has a cast-iron engine breather, instead of the usual type made of thin iron sheeting, which is 600 grams heavier than the usual type. An annual saving of 60,000 kilograms of metal could be effected in this instance; this saving would mean an additional yearly output of 15 trucks.

The importance of reducing the weight of the ZIS-150 engine will be appreciated when one considers that its dry weight is 425 kilograms or, in terms of specific weight, 4.72 kilograms per horsepower. Compared with it, the GAZ-51 engine, which is a highly reliable mechanism, has a dry weight of only 235 kilograms, or a specific weight of 3.65 kilograms per horsepower.

It is well known that as the horsepower of an engine increases, its specific weight decreases. However, if the specific weight of the GAZ-51 is accepted for an engine like the ZIS-150, which is 90 horsepower, the result will be an engine weighing only 300 kilograms [sic], representing a reduction of 125 kilograms. The objection may be raised that two different classes of engines are under consideration. However, what the country needs is not a class of engines but a reliable, cheap, and economical truck.

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For a number of years, single-disc clutches have been used in vehicles of all classes. The possibility of installing this type of clutch in heavy vehicles has been demonstrated in practice at the Yaroslavl' Automobile Plant. The double-disc clutch used in the ZIS-150 is an outmoded mechanism. Expensive to produce and difficult to operate, it weighs about 20 kilograms, without the housing. A single-disc clutch designed for a torque of 31 kilograms per minute, weighs only 10 kilograms.

The housing of the five-step ZIS-150 transmission weighs about 104.5 kilograms. However, there are trucks similar in type to the ZIS-150, whose transmission housings do not exceed 82 kilograms, yet do not suffer frequent breakage. It would therefore be possible to reduce the weight of the ZIS-150 housing without sacrificing reliability. On the other hand, ZIS-150 housings have been known to break on occasions at the point of contact with the clutch; this may be attributed primarily to the excessive weight of the housing.

The rear axle of the ZIS-150, without the wheels and spring, weighs about 470 kilograms. Under dynamic load, this weight causes considerable tension in the axle housing and the frame. It is quite significant that in some trucks the cast axles have been known to break while the vehicles, without load, were in motion. This tends to prove that the dynamic forces exerted were the basic cause for the breakage and that it is pointless to try to strengthen the parts through a mechanical addition of metal. On the contrary, metal should be eliminated wherever it is unnecessary. Moreover, the question whether axles made by casting are to be used in the future should be carefully re-examined.

Having analyzed and summed up the weight of the various parts of the ZIS-150 truck, one may conclude that its weight could be reduced 500 kilograms.

Attention must also be drawn to the production of fastening parts. In some vehicle parts, bolts may be seen protruding 15-20 millimeters from the nut. No kind of standardization can justify such waste.

The solution of the problem of reducing the weight of vehicles must follow certain basic and definite lines. Mathematical and experimental tasks must be carried out with a view to changing the configurations and cross sections of parts, as well as the elimination of unnecessary metal. As a corollary, there must be a radical revision of the designs of antiquated and overweight mechanisms. New methods of heat and mechanical processing of metal which would raise the reliability of parts must be worked out and introduced. New high-grade metals, such as modified iron and light alloys, must be introduced in all the elements of a design whenever possible. Parts produced in accordance with these methods must be subjected to thorough laboratory investigation, then tested in trucks and automobiles under operating conditions.

In carrying out the above tasks, one must allow for a certain amount of experimental risk. If any parts should prove over-reduced and not reliable enough, they may be strengthened after appropriate experiments.

In experimentation, one must not be deterred by the possibility of increasing the cost of an experimental machine through the wide use of light alloys and high-grade steels. Only after the vehicle has been produced and tested, can the total effect be gauged and the necessary corrections made.

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